

PAGAN newsletter 1982

According to legend, the capital city of Pagan was born from a federation of nineteen villages under a local king. Though there is no epigraphic evidence to support this tradition found only in late chronicles, the present landscape is certainly consistent with it. The ancient monuments are widely scattered in an area some 13 by 6 km. on the open plain along Irrawaddy River. Both toward West and South-East, the horizon is gently closed by a small hill range, where a stupa built on each top marks the symbolic boundary of the city. Fields of groundnuts, sesame, and maize, punctuated by toddy-palm trees and thorny bushes, come right to the feet of the monuments, and villages are only seen at close range as the small timber and bamboo houses are clustered under trees and fenced together by the village thorny hedge.

The present sharp contrast between the great religious monuments, witnesses of a rich urban culture, and the quiet rural landscape is certainly the most striking feature. Pagan itself, now just a village at the bend of the river, cannot have changed very much. The palace of King Kyanzittha was a profusely decorated timber structure, whose site is to-day a vacant lot. The only feature which reveals Pagan as a royal capital is now the city wall, built exceptionally in bricks. It does not enclose a very large area, certainly not sufficient for the whole population.

Houses were on the same pattern as to-day, villages were bigger but situated more or less at the same places and probably not much more conspicuous even if they were more numerous. The monuments are not evenly scattered in the plain but are in constellations, a pattern in good accord with the idea of a "federation of villages".

Reliable history begins in 1044 AD when King Anawratha founded the Pagan dynasty. For two and half centuries, up to the Mongol invasion in 1287 AD, Pagan was the very busy capital of the first Burmese kingdom. Its large number of monuments could not have been built without a strong religious enthusiasm and a spirit of national community, enhanced by an efficient economic and practical organization under royal patronage.

To-day, 2217 monuments are officially listed by the Department of Archaeology in the Pagan area. From the most ancient examples of Mon and Pyu inspiration, evolution shows the gradual definition of Burmese classical architecture, together with a shift from Mon writing to Burmese inscriptions. On these grounds, Pagan is rightly looked to as the cradle of Burmese culture and the focus of the establishment

of Theravada Buddhism as a national religion. The aesthetic solutions worked out in Pagan were used as models by the subsequent Burmese dynasties: for instance, the delicately carved timber monasteries of 18th and 19th centuries in central Burma are the evident offspring of Pagan architecture.

The monuments of Pagan display an harmonious balance between unity and diversity:

- **Unity** by their common vocabulary of architectural and decorative patterns, the general use of brick masonry, the similar construction methods.
- **Diversity** in terms of type, scale, shape and decoration.

Types of monuments. The first distinction is between stupa and temple. Stupas are solid monuments, usually a bell-shaped dome resting on receding terraces and crowned by a conical spire. Concealed in the core of masonry, a small cavity shelters relics or ritual precious objects. Temples have an accessible inside space, sometimes of wide proportions. The external shape is usually square in plan topped by tiered roofs or terraces culminating either in a square tower (*sikhara*) or in a circular bell-shape like a stupa. The internal space is designed either around a central vaulted shrine housing a Buddha image or around a central solid pillar framed by a vaulted corridor, with Buddha images set in niches. These two main features can be added to provide a central shrine surrounded by an ambulatory corridor (see the plan of No 1323 Kubyauk-gyi temple in this issue) and the whole composition can be completed by entrance halls and porches on one or several sides. Other types of monuments are monasteries, ordination halls, underground structures, boundary walls with entrance pavilions, etc.

Scale. The range of sizes is very wide, from monuments no bigger than a one-room hut to impressive stupas like Shwezigon or Dhammayazika, or to the famous Thatbyinnyu temple featuring four levels of corridors, two tiers of receding terraces, with a total height of 61 m (201 feet) – equivalent to a modern 20 storey building.

Decoration. The final silhouette of monuments depends upon the features of the upper parts (spire, tower, corner stupas, urns or turrets, etc). Stucco carving on the outside and mural painting inside contribute to make each of the 2217 monuments unique.

The Earthquake of July 8, 1975 in Pagan

There is historical evidence of several earthquakes in Pagan. The *History of Burma*, written by the Minister Twinthin in the 18th century, mentions a devastating shock during the reign of Narapatisithu (1174-1211 AD). Other sources record earthquakes in Pagan in 1286, 1298, 1644, 1768, 1774-75 and 1838 AD, and contemporary inscriptions confirm repairs of seismic damage in Aggate temple (1380 AD), Shwezigon (1777 AD) and Ananda temple (1838 AD).

In recent years, damage was registered on Gawdawpalin temple in 1948, on the Ananda tower in 1965 and on the spire of Mahabodhi temple in 1967.

The earthquake of July 8, 1975 was a more severe one, leaving only a few monuments totally unharmed. Due to the flexibility of the local timber and bamboo houses, there was no human casualties.

Macroseismic studies estimate the intensities at 8 MM in Pagan and Myinkaba, 7 MM at Nyaung-U and Minnanthu and 6 in the rest of the district.

Microseismic data are:

JULY 8, 1975	from I.S.C. (Edinburgh, U.K.)	from N.E.I.S. (Boulder, Co. USA)
Time	GMT 12:04:38	GMT 12:04:42.4
Epicentre latitude	21.42 N	21.485 N
Epicentre longitude	94.62 E	94.7 E
Richter magnitude	Mb=5.9	Mb=6.5
Depth of focus	112 km	178 km

This means a straight distance of about 38 km from epicentre to Pagan village.

The monuments are built of well baked bricks of relatively large size (from 47×33×8cm. to 33×17×4 cm.) joined by mud-mortar. Walls are generously designed, often up to 3 metres wide, supporting carefully voussoired vaults. Foundations are rather superficial, but the large contact surface is a positive factor.

Observed damage fell into three categories:

Structural damage. Structural damage to the upper parts was usually due to an outward movement of the top of the walls and desolidarization of the structure under seismic waves, leading to cracking or opening of vaults and arches, as well as cracks along the lines of least resistance in the walls. In the worst cases vaults and terraces collapsed.

Damage to superstructures. Spectacular, since it destroys the silhouette of the monument, but it does not affect stability: collapse of spires and corner turrets on numerous monuments.

Damage to decorative elements. Generally irreparable: outside, fall of stucco carving (frieze, cornices, pediments, etc). Inside, the fall of stucco plaster-work (on walls and at intrados of vaults) has led to the definitive loss of mural paintings.

These three categories are not, of course, mutually exclusive. The priority list for repair included 44 monuments selected from amongst the best known, most revered and badly affected ones. But in fact the majority of monuments was in some way and to some degree affected and are now either in a fragile condition or have lost part of their mural paintings.

Repairs Activities 1975-1982

The 1975 earthquake caused great concern in Burma, since Pagan has a tremendous cultural and religious importance for all Burmese people, as well as being the key symbol of national unity. In the face of the seismic damage and with the Department of Archaeology already in charge of conservation of monuments, Burmese agencies arranged to co-operate closely under the guidance of a specially set up Advisory Board, manned by experts from Department of Archaeology, Construction Corporation, Rangoon Institute of Technology, Department of Religious Affairs, etc. A special budget was implemented by the Government and financial support came from popular donation all over the country.

Emergency measures helped to prevent further damage: the rainy season occurs in Pagan from August to November and was intense in 1975, but fast action was able to provide temporary tarpaulin protection on the most vulnerable monuments or a first filling of cracks on terraces and roofs. At the same time, sites were cleared of debris and valuable archaeological pieces which had fallen were collected for inventory and custody.

The Advisory Board listed 33 monuments as priorities for the first phase of repair, and the list was later enlarged to 44 monuments. The selection was done on the basis of religious and archaeological importance, and of course on assessment of the condition of the structures. On some other monuments, repairs work was undertaken by the Trustees of Pagoda Council under the supervision of the Department of Archaeology as soon as public donations afford them to begin.

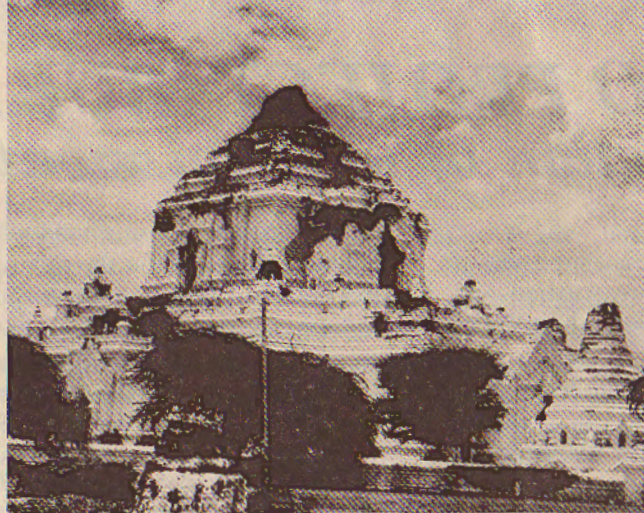
International Assistance. The number of monuments affected and the extent of the damage imposed completely new tasks and responsibilities on the Department of Archaeology in Pagan, who were dramatically short of manpower and equipment. Soon after the earthquake, Unesco provided the services of an architect-restorer, to advise on restoration and conservation measures (see P. Pichard, *The Restoration of Pagan*, Unesco technical report, Paris, 1976). On his advice, urgently needed equipment was provided by Unesco on the following years, including vehicles, hoist, concrete mixer, ladders, scaffolding, etc. Another important contribution was made by the Japanese Government in the form of several lorries and of specialized equipment.

The French Government, on the recommendation of B.P. Groslier, sent to Pagan in 1976 an architectural photogrammetry team from the Institut Géographique National, who recorded 16 monuments and delivered their drawings to the Burmese Government. In addition, French fellowships were provided for four Burmese civil engineers, two for restoration of historic monuments and two for architectural photogrammetry.

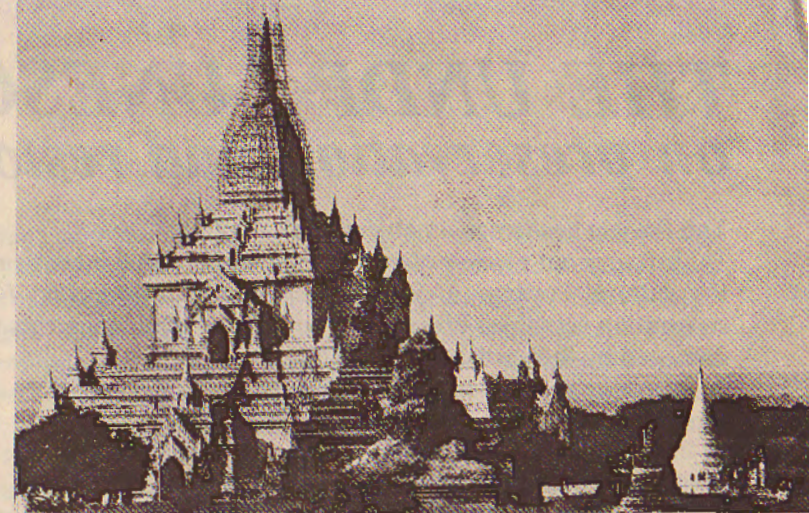
Lastly, the Government of Federal Republic of Germany has given financial support for the restoration of one monument, the temple N° 1791 – Ywa-Haung-gyi, presently under way.



Temple no. 1852 damaged by the 1975 earthquake
Collapse of the vaults on first storey.



Gawdawpalin temple (no. 1622), 1975.
Condition after the earthquake.



Gawdawpalin temple, March 1982.
Repairs work under completion.
This marks the end of repairs for the 44 monuments on the priority list.

Progress of work. The 44 monuments selected by the Advisory Board are now effectively repaired: Gawdawpalin temple, the last one, is being completed in April 1982. The Special Works Unit of Construction Corporation has been commissioned by the Director of the Department of Archaeology to implement the work on these priority monuments. In addition, the Pagan Branch of the Department of Archaeology completed repairs on 71 other monuments, generally on modest size but of great archaeological and artistic interest, and 24 other monuments have been repaired by their respective Trustees, bringing the total to 139.

Total financial investment from 1975 to March 1982:

Government funds:	K. 1,000,000	(US \$ 137,000)
Public donation:	K. 4,260,000	(US \$ 585,000)
Banking interest:	K. 586,700	(US \$ 80,600)
total:	K. 5,846,700	(US \$ 802,600)

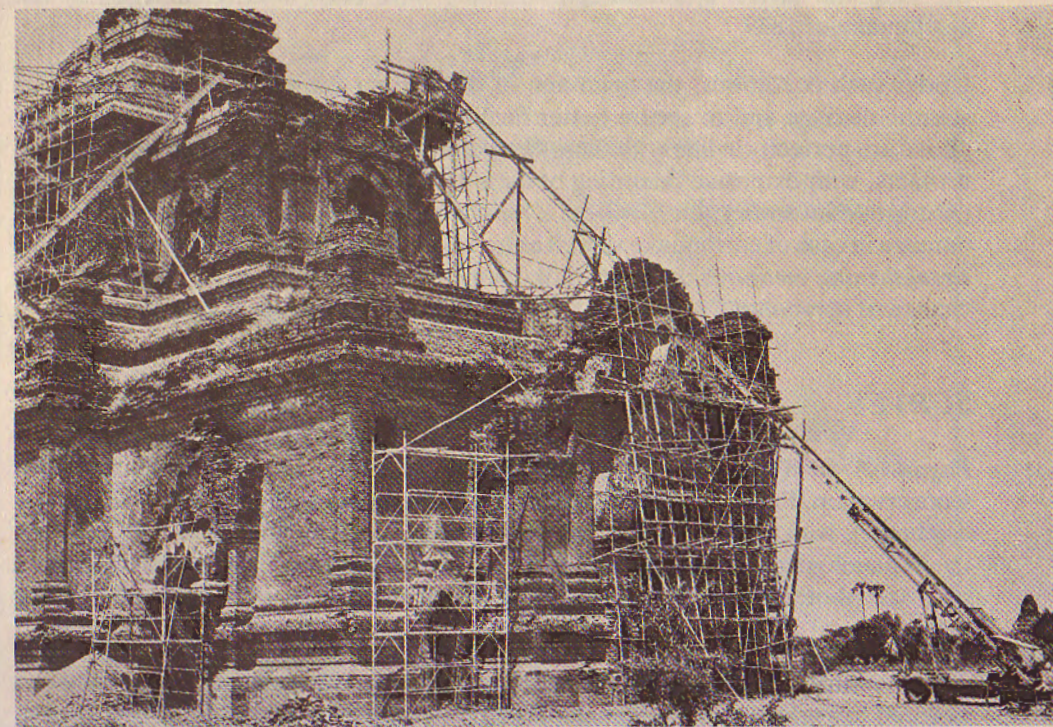
Works expenditures:

by Construct. Corp.:	K. 5,319,800	(US \$ 730,000)
by Dept. of Archæ.:	K. 400,000	(US \$ 55,000)
total:	K. 5,719,800	(US \$ 785,000)

The repaired monuments have now regained their former appearance. However, the work done was generally restricted to the so-called "first phase", i.e. masonry repairing, filling of cracks, reconstruction of collapsed elements with bricks and mortar, refitting of loose stucco parts, etc. Only in a few cases, elements of reinforced concrete have been inserted into the masonry.

A "second phase" is now necessary, aimed at strengthening the structures to ensure the stability of wall-heads, vaults and terraces presently in a weak condition, and to build up the resistance of monuments to future earthquakes.

Ywa-Haung-gyi temple (no. 1791), March 1982.
Under restoration with financial assistance from Federal Republic of Germany.



THE UNDP / UNESCO PROJECT BUR/78/023

on preservation and restoration of national monuments and artifacts

The Project has five main objectives:

- 1 – “to carry out a *survey* of monuments, artifacts and other items considered part of the cultural heritage of Burma, and determine priorities for preservation and restoration activities. Priority will be given to the monuments and murals at Pagan damaged by the earthquake of 1975;
- 2 – to carry out selected preservation and restoration activities including restoration of monuments, artifacts and murals;
- 3 – to undertake specialized *training* of technical personnel with emphasis on application of suitable techniques in the above fields;
- 4 – to *mobilize and co-ordinate* expertise, equipment, supplies and other inputs from external assistance sources for the preservation and restoration of the monuments and murals at Pagan;
- 5 – to propose a plan of action for further *promotion of international assistance* for the preservation and restoration of the cultural heritage of the country.”

The seismic threat is a compulsory criterion for any conservation policy on monuments, not only in Pagan but in most of Burma's Historic sites: seismic hazard is still greater at the later capitals of Ava, Amarapura and Mandalay, which lie right on the long and active Wuntho-Pegu fault and have been heavily damaged by the earthquake of 1839.

Under such conditions, the main aim of the present Project must be to minimize seismic damage and to secure better facilities for its repair. The objectives stated above are perfectly in line with these two points: a detailed *survey* of monuments and artifacts, with extensive recording of each item (photographs, measured drawings, descriptive inventory, etc.) will be a most essential tool for precise assessment of damage in case of earthquake as well as for restoration and conservation. Preventive *strengthening measures* on selected monuments are the only way to improve their chance of surviving.

SURVEY

Pagan. A numbered list of monuments (2217 items) is kept at the office of Conservation, Pagan. On the basis of this, a *descriptive inventory of Pagan monuments* has begun, with card-recording and photographs. Each monument will appear with its archaeological, constructive, decorative and epigraphical data, a sketch ground plan and photograph. An *archaeological map* of Pagan area will be published at the same time.

This inventory is a necessary step: so far, every publication on Pagan has been devoted to a selection of monuments, beginning quite naturally with the best known.

We have now on the one hand some 100 or 150 monuments on which some recording has been done and on the other more than 2000 which have had no data collected about them. This is a dangerous situation because the 30 or 40 best recorded monuments are those which have never been deserted, and have on successive occasions been repaired, frequently whitewashed, and sometimes altered. On the other hand, most of the unrecorded monuments being secondary structures have never been tampered with since Pagan period, and because of their authenticity are of primary archaeological interest.

Other sites. Another inventory will be undertaken for timber monasteries in central Burma, currently in great danger from decay, lack of maintenance, vandalism and fires. Identification and preparatory work for conservation will begin in other historic sites of Burma.

Photogrammetry. Terrestrial photogrammetry equipment (two cameras, one plotter and accessories) is provided to Burma under the Project. As two Burmese specialists have previously been trained in France in that field, actual field work will begin as soon as the equipment is operating. Priority will be given to recording stereo-photographs on Pagan monuments, which will constitute photogrammetric archives available in case of another earthquake. Graphic restitutions will be carried out at a slower pace, according to restoration needs. In addition, sites other than Pagan can be included in the programme.

PRESERVATION AND RESTORATION

With technical assistance from IZIS (Institute of Earthquake Engineering and Engineering Seismology, Skopje, Yugoslavia) the suitable methods for strengthening the monuments of Pagan against future earthquakes will be selected and worked out after scientific evaluation. This will involve:

- Definition of expected seismic parameters at bedrock level in the Pagan region, by study of regional seismicity and elaboration of a seismotectonic map.
- Soil investigation, to analyze the modification of earthquake motion through the soil media from bed-rock to foundation level.
- Final determination of site seismic parameters by assessment of seismic hazard and acceptable seismic risk.
- Ambient vibration testing on selected monuments for determination of dynamic characteristics of the structures, such as vibration periods, mode shapes and damping capacity.
- Formulation of mathematical models of the structures, and selection of optimum methods for their strengthening.

at selected sites in Burma.

15 monuments have been selected for ambient vibration tests, including 6 monuments of outstanding value and 9 selected to be representative of the different types and sizes of monuments. Thus, these tests will yield information on the widest possible range of structures. Detailed application of strengthening methods will be worked out for 5 monuments, with the aim of increasing their capacity to withstand future earthquake without modifying their dynamic characteristics and mass distribution.

Actual implementation of the selected methods will be the next step, with assistance provided through the Project in terms of special equipment, materials and expertise.

Mural paintings and stucco carving. In addition to the structural strengthening of monuments, research has begun on consolidation of stucco, both inside, where it supports the mural paintings, and outside where it constitutes the carved decoration. One monument has been selected as pilot project, and field training will be given by foreign experts to strengthen adherence of stucco to masonry and to improve treatment and conservation of mural paintings.

TRAINING

All field activities carried out by foreign experts involve the active participation of their Burmese counterparts, the aim being for national specialists to gain complete mastery of selected methods and of their applications. In addition, specific fellowships and study tours are provided by the Project. For instance, it is planned to have two engineers from Construction Corporation sent to Skopje to assist and be trained during the computing phase of the strengthening methods selection programme.

FINANCIAL ALLOTMENT

Respective participations in the Project are estimated as K. 2,535,000 (US \$ 350,000) for the Burmese Government and as US \$ 497,800 for United Nations Development Programme.

SCHEDULE

The Project was initially planned to begin in June 1980. Administrative delays postponed its official approval to November 1980. U Bo Kay, Conservator of Pagan (Department of Archaeology) was nominated as National Project Co-ordinator in December 1980, and Pierre Pichard, architect (Ecole Française d'Extrême-Orient) as International Project Co-ordinator.

The **Project Work-Plan** submitted in May 1981 was officially approved by the Implementation Committee on December 28, 1981. The first field missions took place in Pagan in February and March 1982 and included the starting of field work for the **Inventory of Pagan Monuments**, a mission on mural paintings and stucco conservation with preliminary testing of new products and techniques, by P. Schwartzbaum (Iccrom) and O. Nonfarmale (Italy), and a preparatory mission on seismic engineering by P. Gavrilovik (Iziis, Skopje).

The team mission from Iziis is now scheduled for Pagan in October-November 1982 and the definition of strengthening methods can be over by March 1983.

With the actual start in 1981 by the drafting of a detailed work-plan, the Project is about one year behind initial schedule. It will thus be going on until 1984 at least, however a three year extension is presently under consideration

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PAGAN *newsletter*

will be published once a year during the Project's duration.

Kindly send us names of interested persons and institutions for inclusion in our mailing list.

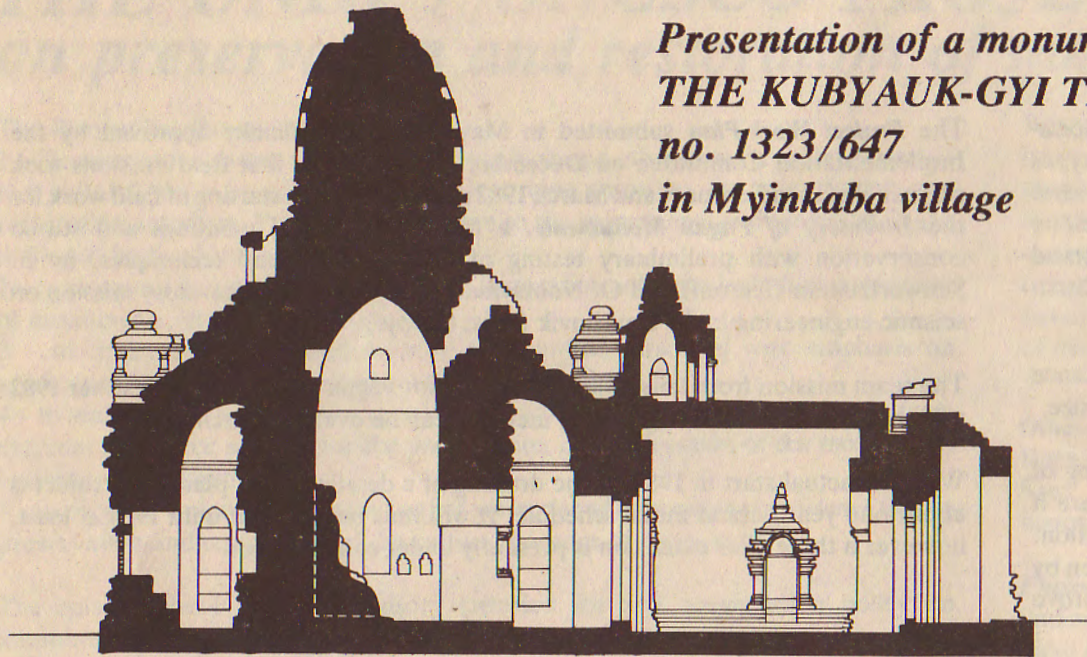
Enquiries and suggestions can be addressed to the following persons:

U BO KAY
Conservator of Pagan
Department of Archaeology
Pagan, BURMA.

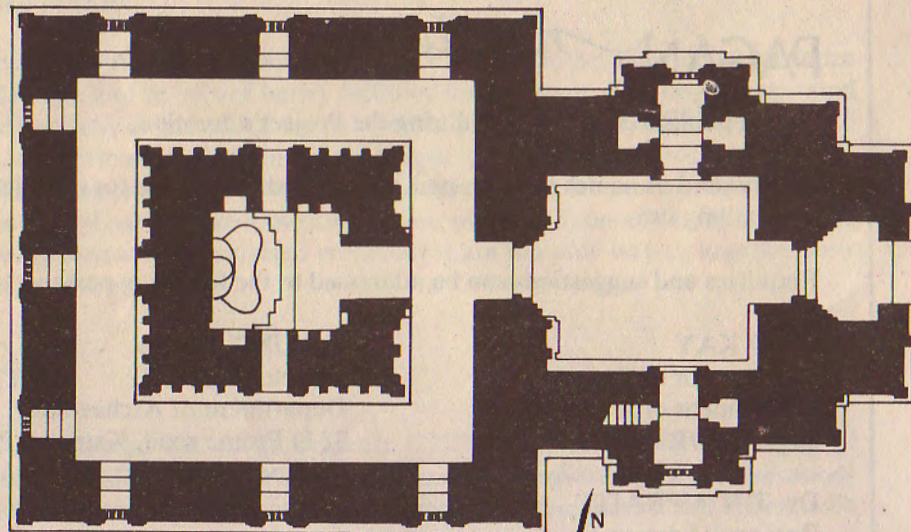
U AUNG THAW
Director-General
Department of Archaeology
32 D Prome road, Kamayut P.O.
Rangoon, BURMA.

Dr. T.N. UPRAITY
Regional Adviser
UNESCO
G.P.O. box 1425
Bangkok, THAILAND.

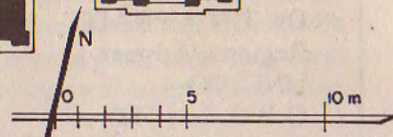
Presentation of a monument:
THE KUBYAUK-GYI TEMPLE
no. 1323/647
in Myinkaba village



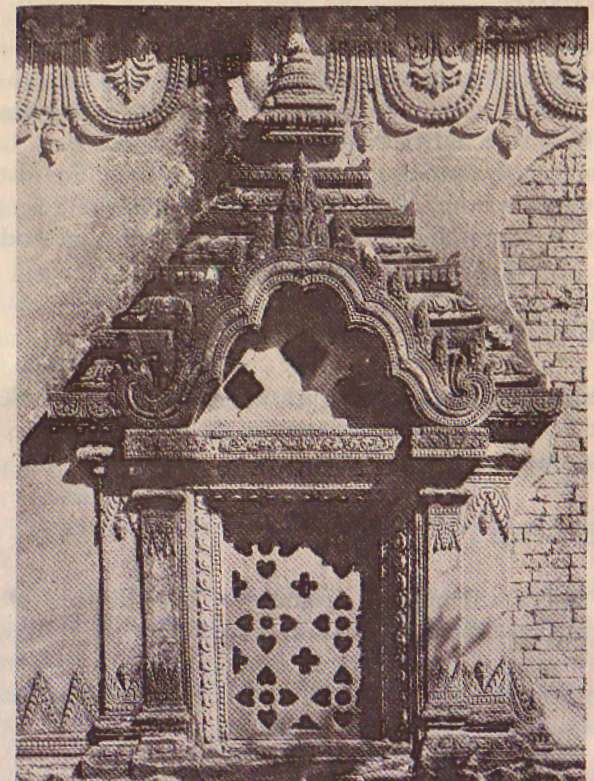
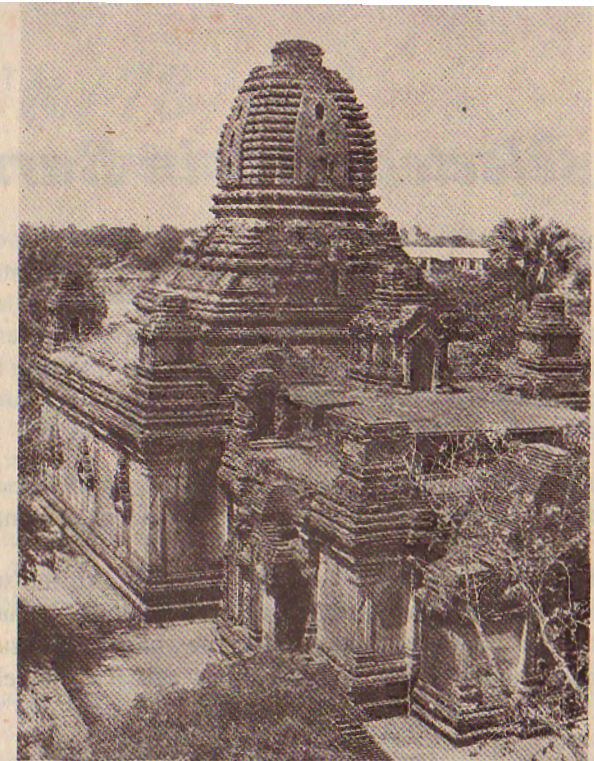
Longitudinal section



Ground plan



South face, detail of the western window



The Kubyauk-Gyi Temple in Myinkaba Village

The temple stands on the north side of Myinkaba village, about 1.7 km. south of Pagan. Its famous "Myazedi" inscription was engraved in duplicate on two free-standing stone pillars, each one featuring on its four faces the same text in four languages: Pali, Pyu, Mon and Burmese.

The inscription gives the date of the ascent to the throne of King Kyanzitha in Pagan as 1084 AD and mentions its fatal illness in 1112 AD. The Kubyaukgyi temple was finished by the king's son and learned minister Rajakumar around 1113 AD.

At the centre of the monument, right under the *sikhara* tower, is the central shrine, a vaulted room measuring 4.35 by 4.85 metres, with the main Buddha image, in masonry, seated on a pedestal. The groined vault, 11.88 high at its apex, rests directly on the walls without any cornice, and must have been decorated with paintings which have disappeared long ago. It was pierced by four skylights, now closed except for the east one. Below, the walls are adorned with niches, some of them still sheltering small stone Buddha images.

Around the shrine is an ambulatory corridor, 2.50 m. wide. The distinct asymmetry of the corridor emphasizes the contrast between the bare outer wall curving upward into the vault and the profusely mouldered inner wall. The vaults of the corridor seem, at first sight, to be the usual half-barrel vaults, but actually are a three-quarters barrel curving slightly down to rest on the inner cornice. Both walls are covered with paintings.

To the east, a great entrance hall is added. This is a large room (7.14 by 8.04 m.) with a full barrel vault 7.54 high, well lit through its east door and two side windows. Fine moulding adorns the hall on the bases of walls and all arches are ornamented with pilasters and pediment, picked out by polychromy still in fair condition in places.

From outside too, the Kubyauk-gyi temple is a good specimen of early Pagan style. The central portion forms a boldly designed square block with continuous base and cornice generously moulded out of stucco. Corner pilasters, with base and capital, underline the vertical angles, and the transition between ornamental mouldings and the plain walls is made by the garlanded frieze and dado which are a constant feature of Pagan architecture.

On each face, the three windows are closed by vertical slabs of sandstone, perforated in various patterns, and framed by floral mouldings and double pilasters supporting a curvilinear flamed pediment, in front of a multi-terraced pavilion silhouette.

The entrance hall is built lower, with foreparts on three sides which divide its walls into smaller panels, thus leaving the full impact of architectural eminence to the central simpler volume. On the north and south, the perforated stone window uses a slightly different pattern. These two lateral windows as well as the axial door were set in pedimented foreparts whose upper portions are now destroyed.

Above the cornice, the central *sikhara* tower rises on top of curvilinear receding roofs. At each corner of the main block stands a square corner turret. On the roof of

the east hall, in addition to four smaller corner turrets, a small complete temple was erected, with mural paintings in the central vaulted shrine and a small porch to the east. As G.H. Luce remarks, this secondary temple on the roof, a feature present in several early Pagan temples, is the forerunner of the numerous later period two storey temples, where the first storey shrine becomes fully integrated under the main tower.

The exceptional quality of the decoration gave an incentive in the selection of Kubyauk-gyi temple as a pilot monument for conservation of stucco carving and mural paintings.

Outside, the stucco is still substantial in places but often endangered since it adheres only loosely to the brick masonry. Furthermore, it is sometimes blackened and weakened by lichen and algae. Roof inspection showed the need for improvement of rain water collection. On a second phase, chemical treatment of stucco will be undertaken.

The mural paintings inside are of particular interest and their Mon legends show the progress already made by Buddhist scholarship only 60 years after the founding of the Pagan kingdom. Paintings on the walls of the corridor are devoted to the creation of the world, the *Jataka* series (previous lives of Buddha), the life of Buddha Gotama, the legendary lives of famous kings and ministers, etc. On the entrance to the hall, impressive figures of Bodhisattva and Brahma are painted.

The paintings show no loss of pigment and will regain their full impact after careful cleaning. Preliminary measures for their safety include the eradication of bats and insects and improvement of the waterproofing of the roof.

Most of the paintings have fallen down from the vaults of the corridor, shrine and entrance hall. Comparison with old photographs does not show recent aggravation and most of these losses were probably due to the decay of the roof and upper portions of the monument prior to its restoration in 1931-33.

The 1975 earthquake brought only slight damage to the temple: a minor crack in the western wall, partial collapse of the corner roof turrets and of the axial roof shrine. Repairs to the masonry have been carried out in the last years.

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G.H. Luce: *Old Burma – Early Pagan*, New York, 1969, Vol. I, pp 373-383, Vol. III, pl 335-450.

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Earthquakes and Historic Monuments

Preventive strengthening of historic monuments against seismic hazard is a relatively new field of scientific investigation. With few exceptions, all attempts so far have aimed, in a more or less intuitive way, at providing additional resistance to masonry structures by inserting heterogeneous elements into them. Such methods involve a strong modification of the stiffness and of the general dynamic response of the structures and can in fact unpredictably increase seismic damage.

The impressive development of seismic engineering in the last 30 years has been mostly devoted to the design of new structures such as multistorey buildings, bridges, dams, etc. But many achievements of this science can, and must now, be applied to the correct repair and strengthening of ancient monuments. A specific approach to this problem must be found, as it is not possible to merely apply seismic design codes which are irrelevant to ancient masonry structures.

Several earthquakes in the past few years brought heavy damage to ancient sites and monuments: Pagan (Burma) in 1975, Friuli (Italy), China and Guatemala in 1976, Montenegro (Yugoslavia) in 1979, and the need for an adapted methodology became more evident.

In 1976, an International Committee for the Protection of Monuments in Earthquake Areas was set up at ICOMOS (International Council on Monuments and Sites) under the chairmanship of Professor N. Ambraseys (London). Unesco and Icomos organized two meetings of experts on this subject, in Paris in 1977 and in Antigua Guatemala in 1979. The urgent necessity of preliminary scientific investigation towards the selection and evaluation of any strengthening technics was stressed in the conclusions of both meetings. This study must include seismic hazard assessment and risk analysis, soil investigation, dynamic analysis of the structures and evaluation of the behaviour of the strengthened monument under expected seismic conditions.

The present Pagan Project will be one of the very first to apply these recommendations systematically. The data collected in the field and the conclusions of the research programme will be valuable for many countries in seismic areas. Though the practical application will be specially designed for Pagan monuments, the methodology involved can be a pilot experiment for similarly threatened sites all over the world.

Addresses for further inquiries:

UNESCO, Division of Cultural Heritage
place de Fontenoy
75700 Paris, France.

ICOMOS Documentation Centre
75, rue du Temple
75003 Paris, France.

